**ANALYSIS OF CIVIL RESERVE AIRFLEET
PARTICIPATION**

GRADUATE RESEARCH PAPER

Scott S. Lew, Major, USAF

AFIT/IMO/ENS/09-04

**DEPARTMENT OF THE AIR FORCE
AIR UNIVERSITY**

AIR FORCE INSTITUTE OF TECHNOLOGY

Wright-Patterson Air Force Base, Ohio

AFIT/IMO/ENS/09-04

ANALYSIS OF CIVIL RESERVE AIRFLEET PARTICIPATION

GRADUATE RESEARCH PAPER

Presented to the Faculty

Graduate School of Engineering and Management

Air Force Institute of Technology

Air University

Air Education and Training Command

In Partial Fulfillment of the Requirements for the

Degree of Master of Logistics

Scott S. Lew, MS

Major, USAF

June 2009

APPROVED FOR PUBLIC RELEASE; DISTRIBUTION UNLIMITED.

AFIT/IMO/ENS/09-04

ANALYSIS OF CIVIL RESERVE AIRFLEET PARTICIPATION

Scott S. Lew, MS
Major, USAF

Approved:

_____//SIGNED//_____   10 JUNE 2009
Pamela S. Donovan   date

AFIT/IMO/ENS/09-04

Abstract

Organizational slack is the cushion of actual or potential resources that allows an organization to adapt to internal or external pressures. Slack resources can come in many forms, such as excess capacity and unused capital. Commercial airlines possess slack in the form of excess capacity, also known as load factor. Due to the increasing pressures to reduce costs and eliminate excess capacity, the commercial carriers constant try to increase their load factors to a breakeven point. One method air carriers use to reach this breakeven point is by participating in the Civil Reserve Air Fleet (CRAF) program. By participating, commercial carriers are eligible for a portion of the $2 billion dollars in annual Department of Defense business and have access to a revenue stream to augment their commercial business and manage slack resources. The purpose of this study was to examine which factors have the greatest influence on CRAF participation. Due to the volatile nature of the airline industry, we examined the roles of organizational slack, financial health, and U.S. economic conditions in CRAF participation. After conducting linear regression of the data, at least two conclusions can be derived from these results: First, the economic conditions that the commercial carriers are experiencing have little bearing on the CRAF participation. Second, the results indicate that the large passenger and integrated cargo carriers are the least likely carriers to want to participate in CRAF. The empirical evidence shows that CRAF participation is driven more by the carrier size, financial health of the carrier, and the carrier type. These results have significant implications for policy changes in the CRAF program. Maintaining a viable incentive program is vital to the long term success of the CRAF program.

Acknowledgements

Table of Contents

List of Tables

Introduction

Organizational slack is the cushion of actual or potential resources that allows an organization to adapt successfully to internal or external pressures. Slack resources can come in many forms, such as excess capacity (Armistead & Clark, 1991) and unused capital (Bourgeois, 1981). Due to narrow profit margins and fierce competition, the commercial airline industry is an industry where managing slack is continually a challenge. Commercial airlines possess slack in the form of excess capacity, also known as load factor. Due to the increasing pressures to reduce costs and eliminate excess capacity, the commercial carriers are constantly trying to increase their load factors to a breakeven point. Since 2000, most large passenger airlines have suffered sharp increases in their breakeven load factors due to sharp drops in passenger yields, rising fuel costs and increases in unit costs (BTS, 2003). The commercial carriers simply cannot completely fill their aircraft with passengers and cargo. Maximizing revenue passenger/ton miles is vital to the commercial carriers maximizing their profits, so every effort is made to fully utilize their aircraft. One method air carriers use to fully utilize their aircraft is by participating in the Civil Reserve Air Fleet (CRAF) program. By participating in the CRAF program, commercial carriers are eligible for a portion of the $2 billion dollars in annual Department of Defense business and have access to a stream of revenue to augment their commercial business and manage slack resources (CLR, 2008).

The commercial airline industry has experienced many years of sizable profits and great losses (GAO, 2002). In the early 1990's, all the major U.S. airlines except Southwest reported losses between 1990 and 1992 (GAO, 2002). After, September 11th, negative financial trends that had begun prior to 2001 were accelerated, with net losses for the industry exceeding $7 billion (GAO, 2002). During these two periods of economic struggles, many of the airlines,

including Braniff, Eastern, Pan Am, United, Trans World Airlines, Northwest Airlines, and

Continental Airlines, either went out of business or filed for bankruptcy. Major airline carrier's

revenues have fallen during these periods of time due to a combination of declines in passenger

enplanements and a significant decrease in average air fares (GAO, 2002). The percentage of

total business that DoD revenue contributes to the larger carriers is often very small, as little as

four tenths of one percentage point of total revenue, while some of the smaller carriers rely

heavily on DoD revenue to stay in business. Even though the amount of revenue generated by

DoD business varies by commercial carrier, it is an important source of revenue for the airlines

during difficult economic times. The financial incentives offered by the DoD to the commercial

carriers are the primary reason for the commercial carriers participating in the CRAF program.

As a result, maximizing the financial incentives to ensure maximum CRAF participation is

fundamental to the DoD meeting the nation's strategic airlift requirements.

Henry "Hap" Arnold noted in 1945 that, "we have learned and must not forget that air

transport is an essential element of air power, in fact all national power" (Reed, 2002: 24). With

the demise of the Soviet empire and the United States' subsequent drawdown of its overseas

military basing requirements, the premise of strategic airlift as a core enabler of national policy

has become increasingly apparent (Sheridan, 2006). The current National Military Strategy

requires the United States to be capable of moving combat forces, equipment, and supplies

anywhere in the world at anytime to respond to crises that threaten national interests. Over the

last few decades, military transportation requirements for moving personnel, equipment, and

other supplies throughout the world has changed considerably. Large-scale military deployments

require sizeable amounts of troops and equipment to be transported, often over large distances

and in short periods of time. In order to accomplish these deployments, land, sea, and air

transportation assets are required. Even though sealift is used to transport the bulk of materials to a combat operation, this mode is slow and takes time. To rapidly deliver combat troops and equipment in a timely manner, strategic airlift must be used.

In 1987, President Reagan emphasized the interdependency of the commercial airline sector and military strategic airlift requirements through National Security Decision Directive 280. The President noted that "it is therefore the policy of the United States to recognize the interdependency of the military and civilian airlift capabilities in meeting wartime airlift requirements and to protect those national security interests contained within the commercial airline industry" (Reagan, 1987). The United State's strategic airlift system is comprised of two critical components, the nation's organic military airlift and commercial air carriers who form the CRAF. The U.S. military does not have sufficient organic airlift forces to accomplish all the airlift requirements that a major combat operation would call for (Barr, 2004). As part of the U.S. National Transportation Policy, the nation turns to the commercial airlines and the assets they posses to augment the military when airlift requirements begin to outpace the available airlift.

The CRAF was created in 1951 to provide supplemental airlift to U.S. military operations worldwide. The program offers a cost affordable alternative to maintaining a sufficiently large enough fleet of organic military aircraft capable of meeting airlift requirements (Kyrouac, 2004). The CRAF program is comprised of commercial air carriers that voluntarily contribute cargo and passenger aircraft and aircrews which are then tasked by U.S. Transportation Command. CRAF carriers own U.S. registered civil transport aircraft that possess the range, payload, speed, and configuration required to perform directed military airlift missions. Commercial carriers are enticed to participate in the program through a system of government incentives. Financial

incentives, in the form of peacetime government cargo and passenger movement business worth approximately $2 billion annually, are rewarded to the carriers based on the number of aircraft that a specific carrier has committed to the program. During its 58-year history, CRAF has only been activated twice; for 10 months during Operation Desert Shield in 1990-91 and for 5 months during Operation Iraqi Freedom in 2003 (Roberts, 2003). Thus, the likelihood of CRAF activation is low and therefore advantageous to the commercial air carriers as a revenue stream and useful in managing slack capacity. The carriers get to participate in a program that provides access to a $2 billion revenue source with very little risk of actually having aircraft pulled away for CRAF activation. By flying day-to-day operations in support of DoD business, the commercial carriers gain access to a steady stream of revenue that can be counted on to supplement normal revenue streams due to the carriers everyday business practices.

Even with the success of CRAF activation during the first Gulf War, the commercial carriers did experience some economic hardships as a result of the activation. Carriers lost market share when their aircraft were transferred from commercial activities to military missions (Daly & Needham, 1999). At the completion of the first Gulf War, two major carriers, American Airlines and United Airlines, dropped out of the CRAF program, while other carriers reduced their level of participation to mitigate some of the risks that are involved when activated.

To help ease the strain on the air carriers during CRAF activation, changes were made in the program following the first Gulf War. Aviation insurance provisions were changed to reduce the risk to carrier's assets and to ensure that an aircraft loss would not put an undue strain on the carrier financially (Daly & Needham, 1999). During peacetime, CRAF partners were allowed to operate from military airfields and to designate these airfields as alternate landing sites in case of inclement weather or emergency situations. Financial offsets were added as well to compensate

a carrier when conducting a CRAF mission whether that aircraft actually flew or not. Commercial carriers who conducted operations in support of the Department of Defense lost airframes for everyday operations. While activated during the Persian Gulf War, the commercial carriers began to lose market share to foreign carriers because the carriers did not have sufficient aircraft to cover their routes (Clarke & Gourdin, 1992). Short lead times and inefficient scheduling by Air Mobility Command during the Gulf War resulted in the commercial carriers having to schedule multiple crews for one aircraft or flying aircraft with no loads on them (Chenoweth, 1993). In today's economically troubled airline industry, the commercial carriers must weigh the advantages of participating in the CRAF program and having access to DoD revenue streams with the small probability of being activated and losing aircraft to DoD directed missions in support of contingency operations.

The purpose of this study was to examine which factors have the greatest influence on air carrier's participation in CRAF. Due to the volatile nature of the airline industry, particularly in recent years, we examined the roles of organizational slack, financial health, and U.S. economic conditions in CRAF participation. The next section reviews the extant literature on organizational slack and the CRAF program. This is followed by a description of the method, hypotheses development, and data analysis. The article concludes with a discussion of the results and managerial implications.

Literature Review

This article begins with a brief overview of organizational slack and capacity management, and then discusses the roots of commercial aviation and how deregulation affects the economic behavior of commercial air carriers. The relationship between the commercial airline industry and the military is then discussed, followed by a history of the CRAF, some of

the issues that the CRAF faces, and how the DoD can offer incentives for commercial airlines to participate in the CRAF program. The DoD relies heavily on the commercial aviation industry to augment its organic fleet with cargo and passenger hauling capability through the CRAF program.

Organizational slack is often defined as the cushion of actual or potential resources that allows an organization to adapt to internal pressures for adjustment or to external pressures for change in policy, as well as to initiate changes in strategy with respect to the external environment (Bourgeois, 1981). Slack is treated as both an advantage and disadvantage. Slack is an advantage when it follows and promotes success, but can be a disadvantage when it contributes to inefficiency. Slack has been suggested to perform four major functions. First, slack can act as an inducement, representing payments in excess of what is required to maintain an organization (Cyert and March, 1963). Secondly, slack can help with conflict resolution, since with sufficient slack there can be a solution for any problem that arises (Tan & Peng, 2003). Thirdly, slack can be employed as a buffer, insulating a firm from environmental disruptions (Tan & Peng, 2003). Finally, slack is used as a strategic behavior facilitator, allowing a firm freedom to experiment with new products or possibly entering new markets (Tan & Peng, 2003).

Organizational slack can be broken down into two categories, absorbed and unabsorbed. Absorbed slack is excess costs in organizations and is not easy to redeploy throughout an organization (Tan & Peng, 2003). Unabsorbed slack corresponds to uncommitted resources which can more easily be redeployed elsewhere in an organization, allowing for greater managerial discretion in business decisions (Tan & Peng, 2003). Because slack represents the degree to which firms either have access to resources in times of unexpected crises or to take

advantage of emergent opportunities, there is a certain level of risk involved with maintaining slack. There have been numerous studies conducted examining the impact of slack resources on a firm's risk-taking behavior. Risk can be viewed as the likelihood that an organization may experience uncertain and volatile income streams (Kim et al, 1993) or it could be considered managerial risk, which consists of those decisions that managers make concerning investing resources in activities with uncertain outcomes (Palmer & Wiseman, 1999). Some other types of decisions related to this type of risk-taking include decisions on innovation, diversification, capacity expansion, and pricing strategies (Artz & Martinez, 2006). These types of decisions are all indicative of decisions made in the commercial airline industry.

The extant literature is divided on whether or not slack resources are beneficial to firms. It is possible that when available slack resources are low, firms primarily focus on their immediate performance issues rather than investing in riskier, but more innovative, projects. As a firm's slack begins to grow though, firms have the flexibility to pursue a greater number of newer, riskier projects. How an organization uses its slack resources is primarily determined by its strategic orientation. While slack may encourage greater risk-taking in externally-oriented firms, internally oriented firms are more likely to use available slack in different manners, primarily as buffers against external forces (Artz & Martinez, 2006).

Organizational slack can take on many forms. One of those forms is uncommitted resources. Organizational slack can be viewed as a pool of excess resources necessary to allow an organization to operate (Nohria & Gulati, 1996). In the commercial airline industry, uncommitted resources can be viewed as unused capacity. Capacity management is a tool that the commercial carriers possess to combat this form of organizational slack. A major factor in the profitability of the airline industry is how well the carriers manage their capacity. Capacity

7

management is the ability of a firm to balance demand from customers and the ability of that firm to satisfy that demand (Armistead & Clark, 2006). This places an emphasis on understanding the options available for managing capacity to meet the expected demand. Managers must understand the composition of their capacity, the degree to which it can be changed, and the speed of reaction to changes as well as the costs involved in implementing those changes (Armistead & Clark, 2006). The ability to change capacity to cope with changes in demand questions the flexibility of capacity. The important issues surrounding changing capacity are the range and response; how far can the capacity be altered, what cost is incurred with changing the capacity, and how easy can the change be made (Armistead & Clark, 2006). Having slack is one mechanism to control capacity. There have been multiple studies conducted on the effects that organizational slack has on innovation and firm performance. The goal of this paper is to measure the effect that organizational slack, in the form of excess capacity, has on the commercial airline industry's participation levels in the CRAF program. The main goal of the carriers is to operate full aircraft, thus minimizing unused capacity on that aircraft and maximizing the revenue generated. One way the commercial carriers can utilize aircraft not filled through normal commercial business operations is to contribute aircraft to the CRAF program, thus becoming eligible for portions of DoD cargo and personnel transportation business.

The long term effects of deregulation are still being debated (GAO, 1999). The airline industry is extremely unstable and most big airlines have suffered some sort of financial loss since the 1980s (CentofFlt, 2009), with only four legacy carriers remaining in the industry. The deregulated environment increased the instability of the carrier's operating profits while competition intensified, increasing the carrier's level of business risk and effecting long term

8

financial decisions by the carrier (Chow, Gritta, & Hockstein, 1988). Profitability in the airline industry is affected by the air carrier's ability to match seat capacity with demand. Low-fare carriers and the major U.S. air carriers have fundamentally different business models, including different route structures and lower operating costs which have resulted in all air carriers taking action to lower costs and restructure their operations. The airline industry as a whole has experienced many years of great profits as well as great losses.

The post-9/11 environment is not the first time that the industry has experienced financial difficulty. During difficult financial conditions, it was not unheard for many major airlines to go bankrupt or out of business, 160 air carriers have filed for bankruptcy or restructuring since deregulation in 1978 with 20 more since 2000 (GAO, 2005). Bankruptcy of the airlines can be attributed to their long-standing corporate structural challenges and weak financial performance in the industry (GAO, 2005). The airline industry is characterized by high fixed costs, cyclical demand, and intense competition. In order to combat mounting financial losses due to an increase in unused seats and a reduction in air fares, the carriers have taken actions to cut costs and boost revenues as well as ground unused aircraft and accelerate the retirement of older aircraft (GAO, 2005).

The nation has long relied on the commercial aviation industry to augment its airlift forces. The CRAF is a voluntary program through which the nation's airlines provide stand-by commitments to support mobilization in the event of a major military contingency requiring activation of CRAF Stages I, II, or III (IDA, 2008). The Finletter Commission, established by President Truman, was tasked to provide guidance on national aviation policies and problems (CLR, 2008). The final report stated that the airlines must be kept strong and healthy to provide a potential auxiliary to the military (CLR, 2008). A second commission, the Douglas

Commission, recommended that a reserve of four-engine civilian airlines capable of trans-atlantic flight be made available to the DoD. In 1951, this report became the basis for organizing the commercial carriers to augment the military airlift system (CLR, 2008).

The U.S. National Airlift Policy, revisited during the Reagan Administration in 1987, provided nine guidelines to meet airlift requirements in peacetime and war (CLR, 2008). As part of this policy, the DoD was tasked to determine the wartime airlift requirement and the amount of organic airlift necessary to meet this requirement while utilizing commercial airlift for other than organic requirements. The Congressionally Mandated Mobility Study (CMMS) of 1980 first stated a requirement goal for airlift capacity. The CMMS stated a goal of 66 million ton miles (MTM) per day of airlift required; of this 20 MTM of cargo capability would be provided by the CRAF program during Stage III, or maximum capacity (CLR, 2008). Over time, the MTM capability has been debated, but the portion of total wartime capability fulfilled by the CRAF has remained relatively stable at 20 MTM per day (CLR, 2008).

To join CRAF, carriers must maintain a minimum commitment of 30 percent of its CRAF capable passenger fleet and 15 percent of its CRAF capable cargo fleet (AMCI 10-402, 2004). When notified of a call-up, the commercial carrier has 24 to 48 hours to respond after the mission is assigned by Air Mobility Command. The CRAF has three main segments: international, national, and aeromedical evacuation (CRS, 2006). The CRAF has been mobilized twice since its creation. The first occurrence was for ten months during Operation Desert Shield in 1990-91 and the second occurrence was for five months during Operation Iraqi Freedom in 2003 (Roberts, 2003). The activation of CRAF stages one and two during Operation Desert Shield consisted of 18 passenger and 23 cargo aircraft (Sheridan, 2006). During the ten months of activation, CRAF aircraft flew 2300 passenger and 2800 cargo missions in support of military

requirements (Sheridan, 2006). The OIF activation of CRAF consisted of 47 passenger and 31 cargo aircraft (Sheridan, 2006). During the five months of activation, CRAF aircraft flew 1625 missions transporting 254,000 troops in support of military requirements (Sheridan, 2006).

The DoD has had some long standing concerns about the current and future economic viability of the CRAF program. By design, the DoD remains dependent upon the commercial carriers for the large-scale movement of personnel (IDA, 2008). The key to continued CRAF viability is a solid base of DoD peacetime business that encourages commercial carriers to participate in the CRAF program while providing those carriers a source of revenue to secure leases and loans for new equipment and lines of credit to ensure current operations (CLR, 2008). So long as the DoD airlift program continues to pay rates that cover the costs and provides the carriers with a market-based fee, economically speaking, there should always be enough carriers willing to contribute enough aircraft to meet the DoD's predictable, steady-state peacetime requirements (IDA, 2008). In every year except for the two years immediately following the Stage II mobilization for Operation Desert Storm, the CRAF program has attracted capability in excess of DoD requirements (CLR, 2008). Post September 11th, the CRAF peacetime requirement has been at record levels, with the carriers the beneficiaries of over $2 billion of DoD peactime business (CLR, 2008).

Financial incentives are the primary means by which the DoD encourages participation in the CRAF program. The commercial carriers are encouraged to participate in the CRAF program by being offered peacetime business in proportion to the airlift capacity that the carrier committed to the program (CBO, 2007). These incentives are there to entice the commercial carriers to participate in the program and mitigate the risk of a disruptive call-up or activation during a contingency. DoD incentives consist of the U.S. General Services Administration

(GSA) City Pairs Program, domestic charter, express cargo-domestic, world-wide express cargo, and business provided by AMC. Through the GSA city pair program, the government has contracted with the commercial airlines for discounted airfares. In return for the discounted airfares, the government has provided the commercial carriers with a source of guaranteed volume revenue and ensures that fare prices stay favorable. The DoD also provides incentives to the commercial cargo carriers by chartering DoD cargo missions to be flown and supported by the commercial carriers, also providing a guaranteed source of revenue to those participating. There are two types of chartered DoD business, "fixed" buy and "expansion" buy. Fixed buys are set contracts between the commercial carriers and the DoD for a given year and expansion buys are contracts bought by DoD as requirements arise. The fixed buy payment is an attractive incentive to carriers to participate in the CRAF program because they can count on this money when formulating their annual business plans.

Current DoD policy is designed to ensure that individual carriers in the CRAF program do not rely too heavily on government peacetime business in their day-to-day operations and thus have little additional capacity to contribute during a wartime surge (CBO, 2007). As such, the DoD 60/40 states that no more than 40 percent of CRAF carrier's revenue should come from DoD business (CBO, 2007). Carriers that exceed this threshold can be penalized by lower limits on the amount of DoD business they obtain in later years. The 60/40 policy helps to ensure that the DoD maintains an airlift surge capacity while also reducing the likelihood that an individual carrier will become solely reliant on DoD business and weaken their competitiveness within the industry.

Method

The CRAF environment is ever changing. To understand how these changes affect CRAF carriers, it is important to analyze changes in the overall commercial air carrier industry. When CRAF was formed the carriers operated in a highly regulated, relatively stable business environment. During this time high value products and mail were the primary commodities transported by air. Today, the commercial air industry is deregulated and air carriers compete intensely for business. Carriers adapted to this new environment by shedding excess capacity and adjusted business strategies to improve their competitive positions. Large air carriers, prior to deregulation, populated their fleets with wide-body aircraft that were more suitable for the city-to-city or more linear routes that existed during that time (Daly & Needham, 1999). The additional costs of operating the larger aircraft on these routes was recaptured through the government's rate setting systems (Daly & Needham, 1999). After deregulation, with the onset of the hub and spoke system of airports, the large carriers found that wide-body aircraft were becoming more unsuitable and too costly to operate for most everyday passenger movement. The flight frequency through the hubs did not provide the necessary passengers per aircraft to make operating the wide-body aircraft profitable (Daly & Needham, 1999). Over the course of the next 15 to 20 years, the carriers began to transition to smaller aircraft that were more suitable for the hub and spoke system (Daly & Needham, 1999). The transition to smaller passenger aircraft led to opportunities for all-cargo carriers to emerge since the smaller aircraft did not have the cargo hold space available that previous larger passenger aircraft possessed. The airline industry continues to feel the effects of decreased passenger travel, rising business costs, and heightened security, all of which impact CRAF participation (Gourdin, 2003).

The purpose of this research is to investigate the concept of organizational slack within the commercial airline industry. The discussion of organizational slack and the CRAF program is related to the number of aircraft that a commercial carrier contributes to the CRAF program and the amount of excess capacity a carrier possesses. Excess capacity for the commercial carriers can be defined in terms of commercial carriers load factor. All commercial carriers have a break-even load factor. Break-even load factor is the average percent of seats or pallets that must be filled on an average flight at current average rates for the airline's revenue to break even with the airline's operating expenses (BTS, 2008). Once that break-even load factor is reached then more revenue trickles down to the carrier's bottom line. Since 2000, most large passenger airlines have suffered sharp increases in their breakeven load factors, due in large part to rising fuel costs (BTS, 2008). Because of the increase, some of the commercial carriers could not cover their operating expenses even if they sold 100% of their seats at average airfares (BTS, 2008). Because breakeven load factor is a ratio of unit cost to passenger or cargo yield, it can be increased by an increase in unit cost or a decrease in passenger or cargo yield, or both (BTS, 2008). The commercial carriers today are experiencing both. The rate of decrease in passenger and cargo yield is higher than the rate of increase in unit costs. The steep decline in passenger and cargo yield is causing the breakeven load factors to rise. In order to combat this increase the commercial carriers need to find a way to supplement their day-to-day business operations with another source of revenue. One alternative source of revenue is the DoD business made available to them through CRAF.

Hypotheses Development

The airline industry is an intensely competitive industry with narrow profit margins. Fraught with financial concerns, particularly during recessionary conditions, the commercial

airlines continually seek to maximize business opportunities. One way to maximize their business opportunities is to ensure full utilization of the airlines excess capacity due to low load factors. Slack capacity for the commercial carriers may be viewed in terms of aircraft load factors. Commercial carriers with high load factors tend to have less slack capacity, while air carriers with lower load factors tend to have more slack capacity. In order to ensure profitability, the commercial carriers must realize load factors that meet or exceed their break-even load factor, on average, across all flights and routes. Therefore air carriers with low load factors, and hence more slack capacity, would be more likely to seek additional revenue streams, such as DoD business through the CRAF program. Therefore, the following relationship between CRAF participation, in terms of aircraft pledged to the program, and load factors is hypothesized:

> H1: The commercial carrier's load factor is inversely related to the number of aircraft a commercial carrier contributes to CRAF.

The CRAF program is an excellent means for the commercial airlines to utilize excess capacity and to maximize their load factors. But the CRAF program also offers the airlines an additional revenue source to augment their revenue streams. The CRAF program is designed to award DoD traffic proportional to the number of aircraft a commercial carrier pledges to the program. Thus, to maximize the opportunity for DoD revenue, a carrier would contribute as many aircraft as possible to the CRAF. Commercial carriers that are financially weak might be more likely to contribute a larger proportion of their fleet to CRAF in order to capture a larger portion of the DoD business. Similarly, commercial carriers that are financially healthy might be less likely to depend on the DoD business as a revenue stream and therefore, less likely to contribute a large proportion of their fleet to the CRAF program. Therefore, the following

relationship between CRAF participation, in terms of aircraft pledged to the program, and

financial health is hypothesized:

> H2: The commercial carrier's financial health is inversely related to the number
> of aircraft a commercial carrier contributes to CRAF.

The financial health of the commercial carrier is not the only financial condition that can

affect CRAF participation levels. The status of the economy is also a factor that can drive

participation. When the economy is strong, passenger and cargo demand rises, resulting in the

commercial carriers utilizing their aircraft to the maximum extent possible. With a good

economy, load factors should be high and there will be little need for the additional revenue

stream DoD business provides. Inversely, when the economy is poor and load factors begin to

lower, the carriers are in need of an additional revenue source, thus DoD business becomes more

attractive to the carriers and participation in CRAF increases. Therefore, the following

relationship between CRAF participation, in terms of aircraft pledged to the program, and the

status of the economy is hypothesized:

> H3: The status of the economy is inversely related to the number of aircraft a
> commercial carrier contributes to CRAF.

Regardless of the status of the economy, due to the highly competitive nature of the

industry, the commercial carriers are constantly looking for alternative means of revenue. One

source of alternative revenue is the DoD business generated by CRAF. The commercial carriers

earn DoD revenue by acquiring mobility value points. Mobility value points are based on the

number of aircraft contributed by a carrier to CRAF. The more aircraft a carrier contributes to

CRAF, the more mobility value points that carrier obtains. This increase in mobility value points

results in potentially more DoD revenue for the carrier. The commercial carriers maximize the amount of mobility value points they can earn by joining with other CRAF airlines to form teams. These teams of airlines pool their mobility value points and then buy or sell the rights to these points to members within their team. The teaming relationship is beneficial to both the large and the small airlines. Therefore, the following relationship between CRAF participation, in terms of aircraft pledged to the program, and the amount of DoD revenue earned is hypothesized:

> H4: The amount of DoD revenue earned is directly related to the number of aircraft a commercial carrier contributes to CRAF.

When the economy is strong, the carriers are in less need of DoD revenue to augment revenue streams. This effect should be more pronounced when applied to a firm who is financially viable. Financially strong firms in a good economy will need the DoD revenue source even less then when the firm is financially weak or the economy is in a downturn. Therefore, the following relationship between CRAF participation, in terms of aircraft pledged to the program, and the amount of DoD revenue earned by the airline is hypothesized:

> H5: The interaction of the status of the economy and the firm's financial health is inversely related to the number of aircraft a commercial carrier contributes to CRAF.

Along the same lines that a financially strong carrier is less likely to contribute to CRAF, a large commercial carrier is less likely to participate as well. Because the larger commercial carriers have a stronger commercial base then the smaller carriers do, the large commercial carriers are not as dependent on the DoD revenue stream to remain financially viable like the smaller commercial carriers are. Therefore, the following relationship between CRAF

participation, in terms of aircraft pledged to the program, and the interaction between the size of

the commercial carrier and the carrier's financial strength is hypothesized:

> H6: The interaction between the size of the commercial carrier and the carrier's
> financial strength is inversely related to the number of aircraft a commercial
> carrier contributes to CRAF.

The integrated and passenger charter carriers have less reliance on DoD revenue due to

their solid commercial bases then due the charter cargo carriers. The charter cargo carriers are

more dependent on the DoD revenue to remain financially viable then the integrated and

passenger carriers. Because of this, the charter carriers look to maximize their DoD revenue by

contributing as many aircraft in their fleet as possible to CRAF to gain the most mobility value

points possible. The charter cargo carriers are also more likely to purchase the mobility value

points from the large passenger and integrated cargo airlines that are in their teams in order to

maximize the DoD revenue the all-cargo carriers can earn. Because the probability of CRAF

stage three activation is low, the commercial carriers contribute the majority of their aircraft to

this stage, earning as many stage three mobility value points as possible. Therefore, the

following relationship between CRAF participation, in terms of aircraft pledged to the program,

and the interaction between the all-cargo carriers and the percentage of aircraft contributed to

CRAF stage three is hypothesized:

> H7: The interaction of the all-cargo carriers and the percentage of aircraft
> contributed to CRAF stage three is directly related to the number of aircraft a
> commercial carrier contributes to CRAF.

Sample and Data

The study sample consisted of domestic, scheduled and chartered, passenger and cargo

commercial air carriers in existence during the 12-year period from 1997-2008 that participated

in the CRAF program. A total of 36 airlines were used in the study. The study focused on the airlines that have participated in the International Long Range, International Short Range, and National Domestic segments of the CRAF program from 1997 to 2008. During this period, not all of the airlines are still viable companies. As a result, some of the airlines that went bankrupt during this time period and did not provide sufficient data for the study were excluded. Two examples of airlines going bankrupt and ceasing operations during the period of the study are Emery Worldwide Airlines and Fine Air Services. Both carriers were CRAF participants until Fine Air Services ceased operation in 2000 and merged with Arrow Air and Emery Worldwide ceased operations in 2001. As a result, financial data and load factor information for these companies was not available for inclusion in the study. Many of the airlines in the CRAF International Short Range segment also routinely only contributed one aircraft to the CRAF program. As a result of this small sample size and the difficulty in finding financial data and load factor information for these smaller airlines, these airlines were excluded from the study. All of the data used in the analysis was derived from two sources, the DoD, specifically Air Mobility Command (AMC), and the Research and Innovative Technology Administration, Bureau of Transportation Statistics. AMC provided yearly summaries on commercial carrier participation in CRAF as well as the amount of contracting dollars the DoD paid to the carriers for movement of DoD passengers and cargo during each of the corresponding years.

Financial data for the individual airlines participating in CRAF during the study period was extracted from the Research and Innovative Technology Administration, Bureau of Transportation Statistics at www.bts.gov. Data collected from the website on each of the commercial carriers consisted of the following: the number of employees, operating revenue,

19

total assets, total profit or loss, shareholder equity, available passenger miles, available ton miles, revenue passenger miles, and revenue ton miles.

Measures

    1. Dependent Variable. The dependent variable, used to measure a commercial carrier's participation level in CRAF, is a standardized measure used by AMC called wide body equivalents (WBEs). Utilizing the aircraft data obtained from AMC, the total number of WBEs each carrier contributed to the CRAF program can be determined by converting the number of aircraft contributed in the program to an equivalent WBE value. In order to account for the amount of lift that a carrier can provide, AMC converts all aircraft contributed by the carriers into a wide-body-equivalent factor. A wide-body equivalent is a relative measure of carrying capacity based on the capacity of one Boeing 747-100 aircraft, which AMC estimates to be 90 tons or 360 passengers (GAO, 2002). To accurately track and monitor the number and type of aircraft each carrier contributes to each section and stage of CRAF, AMC completes an AMC HQ Form 312, "CRAF Capability Summaries"- see appendix X for an example. The AMC HQ Form 312 is broken down into each CRAF program segment and stage. AMC HQ Form 312's from 1997 to 2008 were collected to determine the level of contribution each carrier made to the program over the duration of the study. Operating conditions in the firm during any given year may have either a positive or negative effect on participation in CRAF in the subsequent year. To account for this effect, the independent variables were lagged one year.

    2. Independent Variables. The independent variables used in the analysis include load factor (LF), DoD revenue earned each year, percentage change in annual unemployment, Return on Investment (ROI), commercial carrier employee numbers, and the percentage of aircraft contributed to CRAF Stage 3.

A commercial carrier's load factor is the measure of how much a carrier's carrying capacity is being utilized and is a measure of slack capacity. For a passenger commercial carrier, it is equal to the proportion of revenue passenger-miles flown to seat-miles available. It can also be represented as a proportion of revenue cargo-miles flown to cargo-miles available for cargo commercial carriers. All commercial carriers have a breakeven point load factor in terms of revenue for each use of an aircraft. After a commercial carrier reaches this breakeven point load factor, all revenue brought in from the use of an airplane is profit to the company. High load factors indicate that a carrier is utilizing more of its aircraft's capacity and thus may be reluctant to seek additional DoD business or contribute more aircraft to the CRAF program. Commercial carriers with high load factors have less slack capacity and may be less willing to participate in the CRAF program because carriers do not need to augment lost income due to low load factors with DoD business.

Some commercial carriers have a heavy reliance on DoD business to remain viable. Many of the non-major U.S. commercial carriers, primarily charter carriers, rely heavily on DoD business as a large portion of their total revenue, despite the DoD 60/40 rule preventing any commercial carrier from having DoD business contributing to more than 60% of the company's total revenue. These charter operators are motivated by the opportunity to fly cargo and passenger missions for AMC in peacetime (IDA, 2003). Charter operators generally have less viable commercial sector opportunities then the larger scheduled operators and thus become increasingly dependent on DoD peacetime flying business during economic downturns (IDA, 2003). Under most circumstances, carriers that operate in these conditions have an incentive to maximize their participation in the CRAF program in order to maximize their chances to obtain DoD peacetime business.

The percentage change in annual unemployment was used as a variable to indicate the status of the economy, whether the economy was in a downturn or an upturn. Unemployment rate is most often used as a measure of labor utilization and as an indicator of general economic activity (Lovati, 1976) The unemployment rate is an attempt to estimate the number of persons who want, but cannot find work (Lovati, 1976). Because the unemployment rate is calculated for a specific period time, i.e. every year, it can be related to the yearly financial data and aircraft reports used in the research. In order to determine whether or not a given year was good economically or not, the percentage change in the unemployment rate was taken for the years covering the study. The results from this calculation indicated strong and weak years in the nation's economy.

Return on Investment (ROI) was used as an indicator of a commercial carrier's financial health. The ROI of a company is the ratio of money gained or lost on an investment relative to the amount of money invested. The amount of money gained or lost is equal to the company's net profit or loss. The money invested is equal to the total assets of the company. ROI is used by the airline industry as an indicator of the general level and trend in airline earnings relative to the total investment in operating and non-operating activities (Vernon, 1971). Evaluating a commercial carrier's financial health can be an indicator of participation in CRAF. If a carrier is financially healthy, that carrier may be less dependent on DoD business to maintain viability. In contrast, a commercial carrier with weak financial status or one that is financially distressed may be more heavily dependent on DoD business to remain viable, and therefore will contribute a larger percentage of its fleet to the CRAF program to receive a higher percentage of DoD business.

Employee size allowed for comparisons between the larger and smaller commercial carriers when it comes to participation in CRAF. The number of personnel each company employed during each of the research was used as an indicator of company size.

The CRAF program is broken into three stages. Commercial carriers earn mobility value points for contributing aircraft to each stage of CRAF. Because of the low probability of stage three activation, some of the carriers contribute a larger percentage of their fleet to CRAF stage three then do other carriers. In order to account for this difference in the model, a variable for percentage of total aircraft committed to stage 3 was used.

There were three interaction variables included in the model. The interaction variables highlight the relationships between the variables used in the interactions. The first interaction variable used in the model was percent change in unemployment multiplied by the ROI. This variable highlights the relationship between the status of the economy and a commercial carrier's financial health.

The second interaction variable used in the model was percent aircraft committed to stage 3 multiplied by the all-cargo control variable. All-cargo carriers are hypothesized to be more reliant on DoD revenue to remain economically viable as compared to passenger and integrated commercial carriers. The purpose of this interaction is to highlight the relationship between the percentage of total aircraft committed to stage 3 by an all-cargo carrier as compared to that of a passenger or integrated carrier.

The third interaction variable used in the model was number of employees multiplied by ROI. It is hypothesized that larger, more financially sound commercial carriers are less likely to participate in the CRAF program because they are less dependent on the DoD revenue to remain economically viable because of their already established solid commercial bases. This

interaction variable highlights the relationship between the size of a commercial carrier and its financial strength.

    3. Control Variables. The control variables used in the model include year, all cargo airlines, passenger airlines, and a firm control variable to differentiate the commercial carriers.

    To account for each year of the study, a control variable was used to indicate each year from 1997 through 2008. The corresponding year for the data is important to answer the original hypothesis that commercial carrier participation will be low in good economic years and high in poor economic years.

    In order to study the different levels of participation in the CRAF program between types of commercial carriers, a control variable to account for whether or not a carrier is an all cargo, integrated cargo, or a passenger airline was also used. It is important to distinguish between the types of carriers in order to analyze the level of participation in the program each type of carrier displays.

    Finally, to differentiate between the characteristics of individual firms, a firm control variable was used in the third model. Individual firms demonstrate different characteristics. These characteristics are often intangible and difficult to quantify. Some examples of the differences in firm's characteristics would be a firm's managerial policy, a firm's business model, or its corporate strategy. This firm control variable provides a mechanism to capture the uniqueness of individual firms in the model.

Table 1. Descriptive Statistics		
Variable	Mean	Standard Deviation
WBE YR + 1	7.688884	15.1578241
DoD Revenue	5.195103E7	1.0219842E8
ROI	.018455	.1330309
LoadFactors	.647911	.1315641
% Chg UnEmployment	-1.073736	10.8196574
# of Employees	1.971358E4	3.2512983E4
% AC Stage3	12.5872	26.72877
% Chg UnEmply x ROI	-.055409	1.3286384
% AC Stage3 x Cargo	6.1701	20.72295
Total # Employees x ROI	159.9364	992.24570

Table 2. Pearson Correlations										
	1	2	3	4	5	6	7	8	9	10
1. WBE Yr + 1	1.0									
2. DoD Rev	.025	1.0								
3. ROI	-.045 *	-.017	1.0							
4. LoadFactors	.167 ***	-.272 ***	-.051 **	1.0						
5. % Chg UnEmploy	.023	-.029	-.025	-.088 ***	1.0					
6. # of Employees	.530 ***	-.185 ***	-.047 *	.230 ***	.020	1.0				
7. % ACStage3	.222 ***	.140 ***	-.060 **	-.086 **	-.002	-.104 ***	1.0			
8. % Chg UnEmply x ROI	-.004	.014	.051 **	-.004	.134 ***	-.026	.013	1.0		
9. % AC Stage3 x Cargo	.094 ***	.101 ***	-.027	-.144 ***	-.005	-.111 ***	.704 ***	-.015	1.0	
10. Total # Employees x ROI	.188 ***	-.092 ***	.483 ***	.021	-.191 ***	.463 ***	-.046	.049 *	-.043 *	1.0

*   Significant at 90 percent confidence level
**   Significant at 95 percent confidence level
*** Significant at 99 percent confidence level

Table 1 presents the descriptive statistics for the key study variables in the three models. Table 2 present the Pearson Correlation Coefficients for the key study variables in the three models. The first model, Model 1, tested the hypotheses by regressing the dependent variable, WBE for each carrier, i, in each year, t + 1, on the independent variables: DoD revenue, percentage change in the unemployment rate, return on investment (ROI), load factor (LF), and percent of aircraft committed to stage three, for each carrier, i, in each year, t. The regression also included control variables for each year of the study and whether or not the commercial carrier was all-cargo, integrated, or passenger. The equation for Model 1 is:

$$
\begin{aligned}
WBE\ Yr + 1_{i,t+1} = {} & \propto + \beta_1 DoD\ Revnue_{i,t} + \beta_2 \%\ Change\ in\ Unemployment_{i,t} + \beta_3 ROI_{i,t} \\
& + \beta_4 LF_{i,t} + \beta_5 \#\ of\ Employees_{i,t} + \beta_6 \%\ Aircraft\ Stage\ 3_{i,t} \\
& + \beta_7 All\ Cargo_i + \beta_8 Passenger_i + \beta_9 Year + \varepsilon
\end{aligned}
$$

The second model, Model 2, tested the hypotheses by regressing the dependent variable, WBE for each carrier, i, in each year, t + 1, on the independent variables: DoD revenue, percentage change in the unemployment rate, return on investment (ROI), load factor (LF), percent of aircraft committed to stage 3, the percent change in the unemployment rate multiplied by the ROI, the percent of aircraft committed to stage 3 multiplied by the all-cargo control variable, and the number of employees multiplied by the ROI, for each carrier, i, in each year, t. The regression also included control variables for each year of the study and whether or not the commercial carrier was all-cargo, integrated, or passenger. The equation for Model 2 is:

$$
\begin{aligned}
WBE\ Yr + 1_{i,t+1} = {} & \propto + \beta_1 DoD\ Revnue_{i,t} + \beta_2 \%\ Change\ in\ Unemployment_{i,t} + \beta_3 ROI_{i,t} \\
& + \beta_4 LF_{i,t} + \beta_5 \#\ of\ Employees_{i,t} + \beta_6 \%\ Aircraft\ Stage\ 3_{i,t} \\
& + \beta_7 (\%\ Change\ in\ Unemloyment\ x\ ROI)_{i,t} \\
& + \beta_8 (\%\ Aircraft\ Stage\ 3\ x\ All\ Cargo)_{i,t} + \beta_9 (\#\ of\ Employees\ x\ ROI)_{i,t} \\
& + \beta_{10} All\ Cargo_i + \beta_{11} Passenger_{i,} + \beta_{12} Year + \varepsilon
\end{aligned}
$$

The third model, Model 3 tested the hypotheses by regressing the dependent variable, WBE for each carrier, i, in each year, t + 1, on the independent variables: DoD revenue, percentage change in the unemployment rate, return on investment (ROI), load factor (LF), percent of aircraft committed to stage 3, the percent change in the unemployment rate multiplied by the ROI, the percent of aircraft committed to stage 3 multiplied by the all-cargo control variable, and the number of employees multiplied by the ROI, for each carrier, i, in each year, t. The regression also included control variables for each year of the study and control variables for the firms. The firm control variable is used to test the hypotheses while taking into account the unique characteristics of the individual commercial carriers. The equation for Model 3 is:

$$WBE\ Yr + 1_{i,t+1} = \propto +\beta_1 DoD\ Revnue_{i,t} + \beta_2 \%\ Change\ in\ Unemployment_{i,t}$$
$$+\beta_3 ROI_{i,t} + \beta_4 LF_{i,t} + \beta_5 \#\ of\ Employees_{i,t}$$
$$+\beta_6 \%\ Aircraft\ Stage\ 3_{i,t}$$
$$+ \beta_7 (\%\ Change\ in\ Unemloyment\ x\ ROI)_{i,t}$$
$$+ \beta_8 (\%\ Aircraft\ Stage\ 3\ x\ All\ Cargo)_{i,t}$$
$$+\beta_9 (\#\ of\ Employees\ x\ ROI)_{i,t} + \beta_{10} Year + \beta_{11} Firm_{i,t} + \varepsilon$$

Regression Analysis and Results

Table 3. Regression Results						
	Model 1		Model 2		Model 3	
Variable	Coefficient	t-Statistic	Coefficient	t-Statistic	Coefficient	t-Statistic
(Constant)		-2.298		-2.114		-.051
DoD Revenue	.098	3.522 ***	.098	3.543 ***	.030	.679
ROI	.009	.369	.077	2.506 ***	.011	.314
LoadFactors	.136	4.359 ***	.149	4.785 ***	.011	.195
# of Employees	.546	19.178 ***	.602	18.855 ***	-.687	-4.022 ***
% AC Stage 3	.264	10.634 ***	.361	10.206 ***	.352	9.908 ***
% Chg UnEmploy x ROI			.006	.238	-.005	-.230
% AC Stage3 x Cargo			-.138	-3.608 ***	-.114	-3.028 **

27

Total # Employees x ROI			-.128	-3.407***	-.013	-.299
All-Cargo	-.030	-.522	-.048	-.782		
Passenger	-.117	-2.064**	-.195	-3.256***		
Federal Express					.934	7.302***
Atlas Airlines					.111	2.922***
Northwest (Cargo)					.187	3.727***
UPS					.076	2.146**
American Airlines					.688	8.088***
Miami Air International					-.063	-1.662*
Continental Airlines					.257	5.357***
Delta Airlines					.404	6.114***
Northwest (Passenger)					.402	7.979***
Southwest Airlines					.133	3.134***
Trans World Airlines					.061	1.988***
United Airlines					.573	7.598***
US Airways					.143	3.196***
R^2	.385		.399		.489	
Adjusted R^2	.385		.014		.489	
F	38.606***		34.702***		17.971***	

*   Significant at 90 percent confidence level
**   Significant at 95 percent confidence level
*** Significant at 99 percent confidence level

Multiple variable linear regression was used for the testing of the hypothesized relationships between the dependent and independent variables. The results of the regression are summarized in Table 3. Overall, the regression of the data presented many interesting results. A summary of the supported and not supported hypotheses is in Table 4. Due to unresovable multicollinearity issues, the independent variable percent change in unemployment was excluded from the model when the analysis was conducted and cannot be readily evaluated.

Table 4. Hypotheses Summary				
Hypotheses	Variable of Interest	Model 1	Model 2	Model 3
H1	Load Factor	+, ***	+, ***	+
H2	Return on Investment	+	+, ***	+
H3	% Change Unemployment			
H4	DoD Revenue	+, ***	+, ***	+
H5	% Chg UnEmply x ROI		+	-
H6	Total # Employees x ROI		-, ***	-
H7	% AC Stage3 x Cargo		-, ***	-, **

*   Supported at 90 percent confidence level   + = Positive Coefficient
**   Supported at 95 percent confidence level   - = Negative Coefficient
*** Supported at 99 percent confidence level

Load factor, the indication of organizational slack in the research, was statistically significant in the first two models, but the coefficient of the variable was positive, contradicting the hypothesis that the commercial carriers are more likely to participate in the CRAF program when their load factors are low. Maximizing their aircraft usage and generating high load factors is critical to the financial viability of the commercial carriers. Utilizing CRAF as an avenue for obtaining higher load factors is an option for the commercial carriers when attempting to reach break-even load factors and turning a profit on aircraft operations. In the third model, the significant firm control variables correspond to the large passenger and the integrated commercial carriers. These two groups of carriers are less likely to participate in CRAF than the all-cargo carriers due to their already strong commercial bases and are thus less likely to utilize the CRAF as a means to increase load factors. The characteristics of these carriers, because they

are factored in the third model through the firm control variable, may be one possible explanation for why load factor is an insignificant variable in the third model.

Hypotheses two and five were not supported by any of the three models. ROI was positive and significant in model two, which contradicts the hypothesis that financially weak airlines contribute more to CRAF. A possible explanation for this contradiction is that participation in CRAF is advantageous to carriers whether they are financially strong or weak. The airlines are constantly looking for revenue streams and the stream of revenue provided by the DoD is enticing for any airline. This could result in the larger carriers to continue to participate in CRAF and to gain that extra revenue even when the carrier is financially strong in its other revenue streams.

Due to unresovable multicollinearity issues, the independent variable percent change in unemployment was excluded from the model. As a result, hypothesis three was unable to be evaluated using the data.

Hypothesis four was supported by model one and model two, but not supported by model three. The DoD revenue variable is positive and significant in the first two models, indicating that the more money the DoD pays a commercial carrier, the more likely the commercial carrier is to continue participating in CRAF the following year. In the third model, with the firm control variables included, the DoD revenue is not significant. As noted with load factors, the carriers corresponding to the significant firm control variables are less likely to contribute aircraft to CRAF. Because of this, these carriers will not receive a large amount of DoD revenue, nor do these carriers rely on DoD revenue as significant revenue stream.

Hypothesis six is supported by model two, but not supported by model three. Total # Employees x ROI, is significant and negative in the second model and insignificant in the third

model. This result supports the hypothesis that CRAF participation decreases as the size of the

commercial carrier and the financial health of the carrier increases. In all three models, the size

of the commercial carrier is significant. In the first and second model, the coefficient of the

variable is positive, indicating that the size of the commercial carrier has a direct impact on the

level of participation in the CRAF program. The larger the commercial carrier, the more likely

the carrier is to participating in the CRAF program in the following years. In the third model,

though, the coefficient of the variable is negative, indicating that the size of the commercial

carrier is inversely related to the participation level in the CRAF program. The smaller

commercial carriers are more dependent on the DoD revenue stream then the larger carriers with

more solid financial bases. However, model 3 includes the individual firm control variables,

capturing the unique management practices of those firms. When these control variables are

included, the carrier-specific factors yield interesting results. The control variables for Federal

Express, Atlas Air, Northwest, American, Miami Air, Continental, Delta, Southwest, United, and

U.S. Air are all positive and significant indicating that participation in CRAF stage three is

important to the larger passenger and integrated airlines. One reason for this could be due to the

teaming arrangements that the larger carriers have with the smaller chartered cargo carriers. By

contributing aircraft to CRAF, the larger carriers are obtaining mobility value points, which are

then sold to the chartered cargo carriers in their respective teams. With CRAF stage three

activation unlikely, the larger carriers have nothing to lose by contributing aircraft to stage three,

but gain a revenue stream from selling their mobility value points.

Hypothesis seven was not supported by either model two or three. The variable, % AC

Stage 3 x All-Cargo is significant and negative in the second and third model. This result is in

contradiction to the hypothesis that CRAF participation levels increase in relation to the

interaction between an all-cargo carrier and the percentage of total aircraft in Stage 3 that carrier provides. It was hypothesized that since the cargo carriers are more reliant on DoD revenue in their business model, that the all-cargo commercial carriers would have a higher percentage of their aircraft in Stage 3 to facilitate maximizing their MVPs. The data indicates that classifying a commercial carrier as all-cargo, passenger, or integrated has little bearing on the percentage of total aircraft committed to Stage 3 and the overall effect on the CRAF participation.

There were a few limitations discovered during this study that warrant future study and consideration. First, the data used in the study was incomplete due to the volatile nature of the airline industry. Not all of the financial data relating to individual airlines was on the Bureau of Transportation Statistics website. Also, the annual SEC financial findings, which were used to determine the aircraft fleet sized for individual airlines, were not available for all the airlines. Some of the airlines participating in the CRAF program went bankrupt of completely out of business during the period of the study, also resulting in missing data for those airlines. Finally, the study was conducted using only stage three participation levels. Stage one and stage two data was left out of the analysis due to time and resource constraints.

The teaming arrangements that the commercial carriers participate in as part of the CRAF program were not studied for this research. The teaming arrangements have a large impact on the amount of DoD revenue a carrier obtains as well as the number of aircraft that a carrier contributes to the CRAF program. Evaluating the effects that the teaming arrangements have on participation levels, such as evaluating the number of mobility value points a commercial carrier obtains as opposed to the number of wide-body-equivalents a carrier contributes, and the amount of DoD revenue earned would be a valuable addition to this research.

MANAGERIAL IMPACT AND CONCLUSIONS

This study linked the participation in the CRAF program by the commercial airline industry with organizational slack or the cushion of actual or potential resources that allows an organization to adapt successfully to internal or external pressures. The research conducted in the study led to seven hypotheses. The research did not support all of the hypotheses, but it did offer a link between organizational slack, in this case excess capacity by the airlines in the form of load factors, with participation levels in the CRAF program. The DoD relies heavily on the CRAF to augment the organic strategic airlift fleet to meet all of the DoD's airlift requirements. Three regression models were estimated to determine the impact that load factors, DoD revenue, financial strength, firm size, and the condition of the economy all have on participation levels in the CRAF program.

At least two conclusions can be derived from these results: First, the economic conditions that the commercial carriers are experiencing have little bearing on the participation in CRAF. Whether or not the economy was in an upturn or a downturn did not affect the participation levels of the commercial carriers. This is an important finding due to the commonly held perception that during economic recessionary periods air carriers are more dependent on CRAF. Second, the results indicate that the large passenger and integrated carriers are the least likely carriers to want to participate in CRAF. The empirical evidence shows that participation in CRAF is driven more by the carrier size, financial health of the carrier, and the carrier type, i.e. passenger or cargo. This is an important note because the large carriers are also the carriers that currently contribute the most aircraft to the CRAF program. The small carriers with weaker financial positions are more likely to participate in CRAF than the larger, financially healthy carriers. Furthermore cargo carriers are less likely to participate in CRAF

stage three, but instead depend on DoD business in the earlier stages of CRAF and rely on the larger scheduled passenger and integrated cargo carriers to contribute the bulk of aircraft to stage three. These results have significant implications for policy changes in the CRAF program, particularly as US Transportation Command revises its incentive program. The research supports the recommendations for US Transportation Command to adopt an Assured Business Model, which adapts DoD supply-chain management principles to DoD civil aviation support, made by Institute for Defense Analyses 2008 CRAF Viability Study. The research advocates a legislative change for the Assured Business Model to set-aside DoD cargo business for CRAF carriers following a drawdown in Iraq and Afghanistan. Maintaining a viable incentive program to continue to entice these carriers to participate in the CRAF program is vital to the long term viability of the CRAF program. The Assured Business Model cargo set-aside would bolster small cargo carriers and overall strengthen the Air Transportation Industry. Just as President Reagan did in 1987 when he noted the interdependency of the military and civilian airlift capabilities in meeting wartime airlift requirements and to protect those national security interests contained within the commercial airline industry, it is time to emphasize this interdependency again with regards to the nation's National Transportation Policy.

REFERENCES

Anderson C., & Schumacker R.E., 2003. *A Comparison of Five Robust Regression Methods With Ordinary Least Squares Regression: Relative Efficiency, Bias, and Test of the Null Hypothesis.* Denton, TX: University of North Texas, College of Education.

Armistead, C.G. & Clark, G. 1991, *Capacity Management In Services and the Influence On Quality and Productivity Performance.* Paper presented at the British Academy of Management Conference, Bath.

Artz, K. & Martinez, R. J. 2006. An Examination of Firm Slack and Risk-taking in Regulated and Deregulated Airlines. *Journal of Managerial Issues,* 18(1): 11-31.

Barr, J.A. 2004. *Impact of Insufficient Inter-Theater Airlift Assets on National Strategic Decision-Makers.* Unpublished Strategy Research Project, United States Army War College, Carlisle Barracks, Pennsylvania.

Bourgeois, L. J. 1981. On the measurement of organizational slack. *Academy of Management Review,* 6: 29-39.

Bureau of Transportation Statistics (BTS), 2003. Rising Breakeven Load Factors Threaten Airline Finances. October 8.

Chenoweth, M. 1990. *The Civil Reserve Air Fleet: An Example of the Use of Commercial Assets to Expand Military Capabilities During Contingencies.* Case No. N-2838-AF. Santa Monica, California: RAND Corporation.

Chow, G., & Gritta R.D., & Hockstein R. 1988. Airline Financing Policies in a Deregulated Environment. *Transportation Journal,* Spring: 37-48

Clark, R.L. & Gourdin, K.N., 1992. Winning Transportation Partnerships: Learning from the Desert Storm Experience. *Transportation Journal,* Fall: 30-37

Crackel, T. J. 1998. Roots of the Civil Reserve Air Fleet. *Air Power History,* Winter: 26-43

Congressional Budget Office. *Issues Regarding the Current and Future Use of the Civil Reserve Air Fleet.* Report to Congress. Washington DC: October 2007

Congressional Research Service. *Civil Reserve Air Fleet (CRAF).* Report to Congress. Washington DC: October 2006

Council for Logistics Research. *Civil Reserve Air Fleet Study Report.* Report to Air Mobility Command. Scott AFB, IL: July 2008.

Cyert, R., & March, J. 1963. *A Behavioral Theory of the Firm.* Prentice-Hall: Englewood Cliffs, NJ.

Daly, J.D., & Needham, P.M. 1999. Air Transportation: Elements of a Changing Environment and What It Means to the Civil Reserve Air Fleet. ***Defense Transportation Journal,*** December: 6-11

Department of the Air Force. *Civil Reserve Air Fleet.* AMCI 10-402. Washington: HQ USAF, 1 September 2004

Gourdin. K.N., 2003. An Industry in Crisis. ***Defense Transportation Journal,*** August: 3

Institute for Defense Analysis. ***Sustaining the Civil Reserve Air Fleet (CRAF) Program.*** Report to the Office of the Deputy Under Secretary of Defense for Logistics and Material Readiness. Washington DC: May 2003.

Institute for Defense Analysis. ***Civil Reserve Air Fleet: Economics and Strategy.*** Report to U.S. Transportation Command. Scott AFB, IL: August 2008.

Kim, W. C. & Hwang, P. & Burgers, W. P. 1993. Multinationals' Diversification and the Risk-return Trade-off. ***Strategic Management Journal*** 14(4): 275-286.

Kyrouac, R. A. 2004. ***Civil Reserve Air Fleet: A Rough Road Ahead.*** Unpublished thesis paper, United States Naval War College, Newport, Rhode Island.

Lewis, I. 1998. The Civil Reserve Air Fleet: Balancing Risks and Incentives. ***Transportation Journal,*** Winter: 32-39

Lovati, J.M. 1976. The Unemployment Rate as an Economic Indicator. ***The Federal Reserve Bank of St. Louis.*** September: 2-9

Nohria, N. & Gulati, R. 1996. Is Slack Good or Bad for Innovation? ***The Academy of Management Journal.*** 39(5): 1245-1264

Palmer, T. B. & Wiseman, R.M. 1999. Decoupling Risk Taking from Income Stream Uncertainty: A Holistic Model of Risk. ***Strategic Management Journal*** 20: 1037-1062.

Reagan, R. President of the United States. ***National Security Decision Directive Number 280: National Airlift Policy.*** Washington D.C.: The White House, 24 June 1987.

Reed, T.S. 2002. Air Mobility: Simultaneous Enhancement of Airpower Legitimacy and Security Dilemma Amelioration. ***Air Force Journal of Logistics,*** 26: 24-32

Roberts, C. 2003. Civil Reserve Air Fleet Stage I Activates for Only Second Time In
History. ***Airman,*** April: 14

Sheridan, J.D. 2006. ***Civil Reserve Air Fleet (CRAF): A Participation Analysis 1986-
2005.*** Unpublished Graduate Research Project, United States Air Force Institute of
Technology, Wright-Patterson AFB, Ohio.

Tan, J., & Peng, M.W. 2003. Organizational Slack and Firm Performance During
Economic Transitions: Two Studies From an Emerging Economy. ***Strategic
Management Journal,*** April: 1249-1263.

The Post Office Flies the Mail, 1918-1924.
http://www.centennialofflight.gov/essay/Government_Role/1918-1924/POL3.htm, first
accessed February 2009.

U.S. General Accounting Office. ***Airline Deregulation: Changes in Airfares, Service
Quality, and Barriers to Entry.*** Report to Congressional Requesters.
Washington, DC: March 1999.

U.S. General Accounting Office. ***Commercial Aviation: Financial Condition and
Industry Responses Affect Competition.*** Testimony before the U.S. Senate
Committee on Commerce, Science, and Transportation. Washington, DC: October 2002.

U.S. General Accounting Office. ***Military Readiness: Civil Reserve Air Fleet Can
Respond as Planned, but Incentives May Need Revamping .*** Report to the U.S. House
of Representatives Subcommittee Chairman on Military Readiness and Committee on
Armed Services. Washington, DC: December 2002.

U.S. General Accounting Office. ***Commercial Aviation: Bankruptcy and Pension
Problems are Symptons of Underlying Structural Issues.*** Report to Congressional
Committees. Washington, DC: September 2005.

U.S. General Accounting Office. ***Commercial Aviation: Preliminary Observations on
Legacy Airlines' Financial Condition, Bankruptcy, and Pension Issues.*** Report to
Congressional Committees. Washington, DC: June 2005.

Vernon, T.H., 1971. Air Carriers' ROI, Probing the Mysteries. ***Financial Analysts
Journal.*** January-February: 44-53

Werrell, K.P. 2003. The Dark Ages of Strategic Airlift: The Propeller Era. ***Air Power
History,*** Fall: 20-33

Maintaining the Civil Reserve Air Fleet

Scott S. Lew, Major, USAF
Pamela S. Donovan, Lt Col, USAF
Air Force Institute of Technology
Department of Operational Sciences
AFIT/ENS 2950 Hobson Way
Wright-Patterson Air Force Base,
Dayton, OH 45433-7765

The use of civilian aviation for military purposes began shortly after the U.S. Post Office began to move mail by air in the 1920's. The United State's strategic airlift system is comprised of two components, the nation's organic military airlift and commercial air carriers who form the Civil Reserve Air Fleet (CRAF). The CRAF is a voluntary program through which the nation's airlines provide stand-by commitments to support mobilization in the event of a major military contingency.

Financial incentives are the primary means by which the DoD encourages CRAF participation. The commercial carriers are encouraged to participate in CRAF by being offered peacetime business in proportion to the airlift capacity that the carrier committed to the program. These incentives are there to entice the commercial carriers to participate in the program and mitigate the risk of a disruptive call-up or activation during a contingency. By participating in the CRAF program, commercial carriers are eligible for a portion of the $2 billion dollars in annual Department of Defense business.

The commercial airline industry has experienced many years of sizable profits and great losses. During two periods of economic struggles, the early 1990's and after September 11th, many of the airlines either went out of business or filed for bankruptcy. Airline revenues have fallen during these periods due to declines in passenger enplanements and significant decreases in average air fares. Even though the amount of revenue generated by DoD business varies by commercial carrier, it is an important source of revenue for the airlines.

The Department of Defense (DoD) has had some long standing concerns about the current and future economic viability of the CRAF program. By design, the DoD remains dependent upon the commercial carriers for the large-scale movement of personnel. The key to continued CRAF viability is a solid base of DoD peacetime business that encourages commercial carriers to participate in the CRAF program while providing those carriers a source of revenue to secure leases and loans for new equipment and lines of credit to ensure current operations.

A recent study, utilizing Bureau of Transportation Statistics and Air Force CRAF data, set out to determine quantitative factors that could be used to predict the future participation levels of commercial airlines in CRAF. The study compared the participation levels of various commercial airlines to factors that could affect their participation such as aircraft utilization, or load factor, the financial health of the airline, and the status of the economy.

Initial findings of the study found that the economic conditions that the commercial carriers are experiencing have little bearing on the participation in CRAF. The results indicated that the airline's load factor, though statistically significant, had the opposite effect on participation then hypothesized. Instead of a decreasing load factor indicating participation, the data showed that an increase in load factor indicated an increase in participation. The results also indicate that the large passenger and integrated carriers are the least likely carriers to want to participate in CRAF. Participation in CRAF is driven by three factors; carrier size, financial health, and carrier type, i.e. passenger or cargo. Carrier size is statistically significant and positive only when carrier type control variables are included, but negative when firm control variables are used. This indicates that when individual firm characteristics are included, larger firms are less likely to participate in CRAF, but when carrier type is evaluated, the larger the firm, the more CRAF participation. Financial health is statistically significant and positive, indicating that the more financially healthy a firm, the more likely CRAF participation will be. Finally, carrier type is statistically significant and positive, indicating that passenger airlines are more likely to participate in CRAF then cargo airlines.

Three models were used in the analysis of CRAF participation amongst the commercial airlines. The models compared the number of wide-body-equivalent aircraft a commercial airline contributed to CRAF against factors that could affect participation. The variables analyzed included DoD revenue earned, the airlines return on investment (ROI), the airlines load factor (LF), the size of the airline, the percentage of aircraft that an airline committed to CRAF stage three and the percentage change in unemployment. Control variables for the airline type and the year of the data were also included in the model. The three models were determined to be statistically significant and are shown below. The coefficients of determination or R2 for the models were determined to be 38.5%, 39.9%, and 48.9%.

The results of the study have significant implications for policy changes in the CRAF program, particularly as US Transportation Command revises its incentive program. The research supports the recommendations for US Transportation Command to adopt an Assured Business Model, which improves the incentives and business practices facing USTRANSCOM suppliers and customers, and adapts proven supply chain management principles to DoD civil aviation support. The research advocates a legislative change for the Assured Business Model to set-aside DoD cargo business for CRAF carriers following a drawdown in Iraq and Afghanistan. Maintaining a viable incentive program to continue to entice these carriers to participate in the CRAF program is vital to the long term viability of the CRAF program.

Major Scott S. Lew is a Masters IDE student at the Air Force Institute of Technology, Wright-Patterson AFB, Ohio in the Department of Operational Sciences. Following graduation, Maj Lew will be assigned to the Joint Warfare Analysis Center, Unites States Joint Forces Command, Dahlgren, VA.

Lieutenant Colonel Pamela S. Donovan is an Assistant Professor of Logistics and Supply Chain Management at the Air Force Institute of Technology, Wright-Patterson AFB, Ohio in the Department of Operational Sciences.

REPORT DOCUMENTATION PAGE

1. REPORT DATE *(DD-MM-YYYY)*	2. REPORT TYPE	3. DATES COVERED *(From – To)*
05-06-2009	Graduate Research Paper	May 2008 – June 2009

4. TITLE AND SUBTITLE	5a. CONTRACT NUMBER
Analysis of Civil Reserve Air Fleet Participation	5b. GRANT NUMBER
	5c. PROGRAM ELEMENT NUMBER

6. AUTHOR(S)	5d. PROJECT NUMBER
Maj Scott S. Lew	5e. TASK NUMBER
	5f. WORK UNIT NUMBER

7. PERFORMING ORGANIZATION NAMES(S) AND ADDRESS(S)	8. PERFORMING ORGANIZATION REPORT NUMBER
Air Force Institute of Technology Graduate School of Engineering and Management (AFIT/EN) 2950 Hobson Street, Building 642 WPAFB OH 45433-7765	AFIT/IMO/ENS/09-04

9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES)	10. SPONSOR/MONITOR'S ACRONYM(S)
AMC/A3B Attn: Mr. Merle Lyman 402 Scott Drive Scott AFB, IL 62225	11. SPONSOR/MONITOR'S REPORT NUMBER(S)

12. DISTRIBUTION/AVAILABILITY STATEMENT
APPROVED FOR PUBLIC RELEASE; DISTRIBUTION UNLIMITED

13. SUPPLEMENTARY NOTES

14. ABSTRACT Organizational slack is the cushion of actual or potential resources that allows an organization to adapt to internal or external pressures. Slack resources can come in many forms, such as excess capacity and unused capital. Commercial airlines possess slack in the form of excess capacity, also known as load factor. Due to the increasing pressures to reduce costs and eliminate excess capacity, the commercial carriers constant try to increase their load factors to a breakeven point. One method air carriers use to reach this breakeven point is by participating in the Civil Reserve Air Fleet (CRAF) program. By participating, commercial carriers are eligible for a portion of the $2 billion dollars in annual Department of Defense business and have access to a revenue stream to augment their commercial business and manage slack resources. The purpose of this study was to examine which factors have the greatest influence on CRAF participation. Due to the volatile nature of the airline industry, we examined the roles of organizational slack, financial health, and U.S. economic conditions in CRAF participation. After conducting linear regression of the data, at least two conclusions can be derived from these results: First, the economic conditions that the commercial carriers are experiencing have little bearing on the CRAF participation. Second, the results indicate that the large passenger and integrated cargo carriers are the least likely carriers to want to participate in CRAF. The empirical evidence shows that CRAF participation is driven more by the carrier size, financial health of the carrier, and the carrier type. These results have significant implications for policy changes in the CRAF program. Maintaining a viable incentive program is vital to the long term success of the CRAF program.

15. SUBJECT TERMS
Civil Reserve Air Fleet, Organizational Slack, Commercial Airline Industry

16. SECURITY CLASSIFICATION OF:			17. LIMITATION OF ABSTRACT	18. NUMBER OF PAGES	19a. NAME OF RESPONSIBLE PERSON Pamela S. Donovan, Lt Col, USAF
a. REPORT	b. ABSTRACT	c. THIS PAGE	UU	49	19b. TELEPHONE NUMBER *(Include area code)*
U	U	U			(937)255-3636,ext 4510;email:pamela.donovan@afit.edu